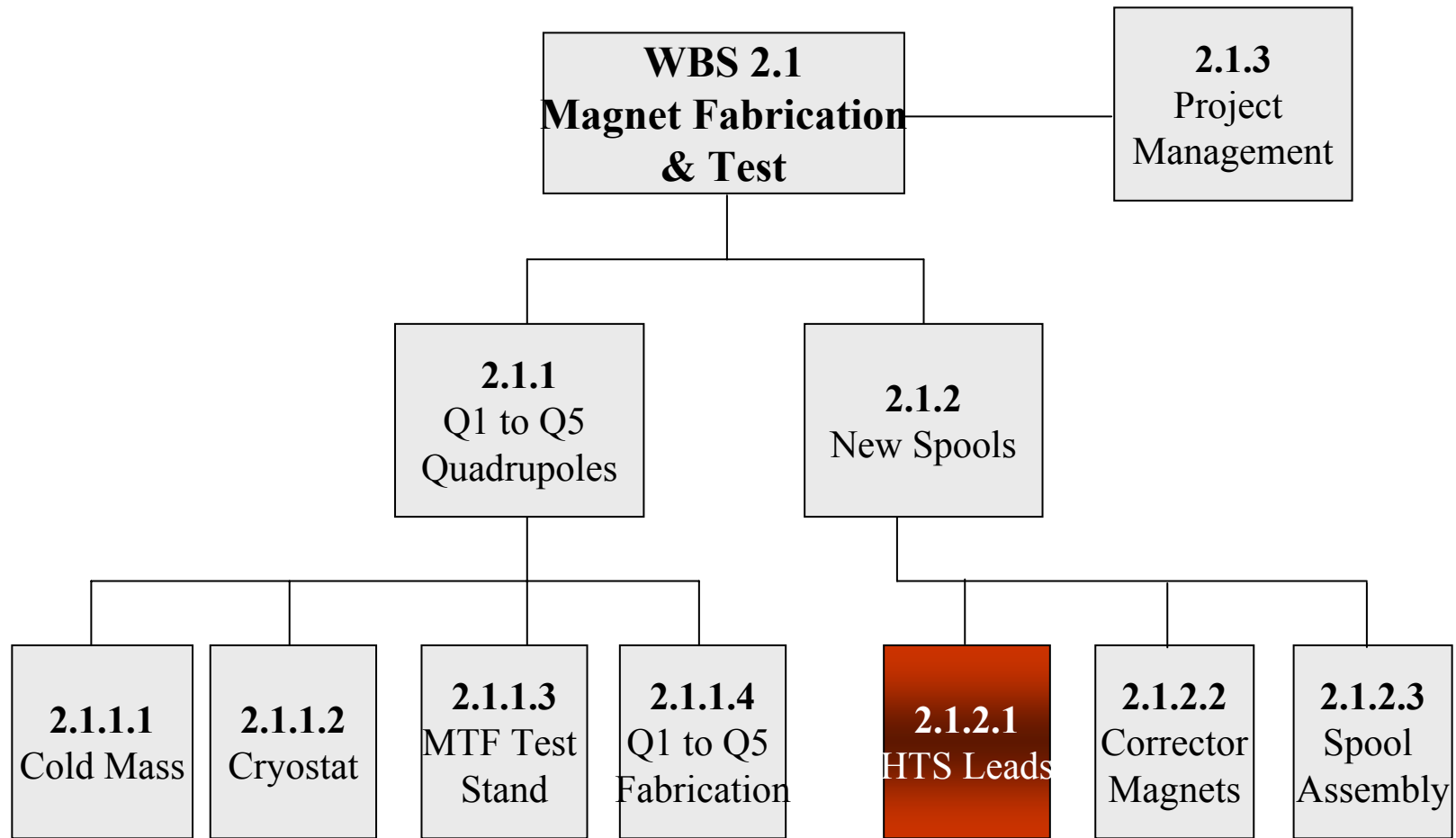


# HTS Leads (WBS 2.1.2.1)

S. Feher

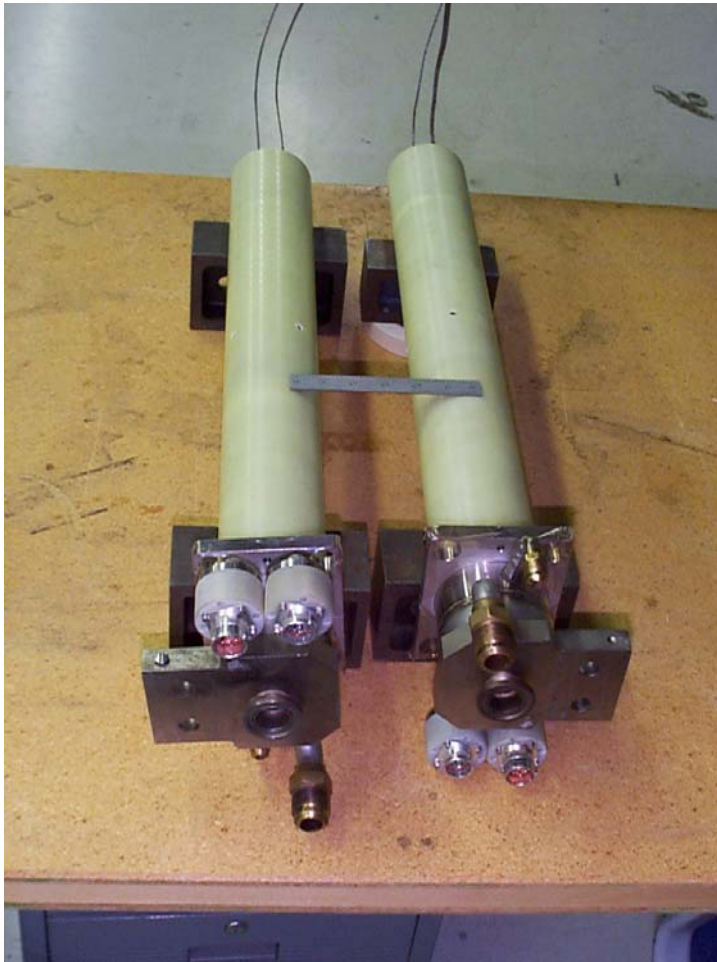
Where we are in the WBS structure:



- HTS Lead requirements:
  - Gas cooled power lead operating between 300 – 4.3 K.
  - Maximum operating current 9500A (with a margin of 500A).
  - Case leak rate to vacuum  $< 2 \times 10^{-8}$  atm cc/sec.
  - Maximum voltage drop of 0.2 Volts per lead at rated current.
  - Low  $\sim 0.04$  g/sec LHe vapor consumption.
  - Thermal intercept at 80-82K.
  - Voltage standoff to ground or other lead  $> 2000$ V.
  - Magnetic field environment  $< 100$  gauss.
  - Radiation environment  $\sim 1$ -5 Rad/hour.
  - Cool down rate from 80K to 4.3K within 60 sec.
  - Robustness, thermal cycle etc.

- 6000A HTS leads at the Tevatron

American Superconductor Co



TSHH Spools



- HTS Leads needed:

Spool	Location	Slot Length, m	VD T. m	HD T. m	SQ T.m/m	Sx T.m/m <sup>2</sup>	Q* T.m/m	BPM	HTS Leads	Other Leads
X1V	packb43	1.83	0.48			450	25			3x50A+SL
X1H	packb44	1.83		0.48		450	25			3x50A
X2L	packb47	1.43	0.48	0.48				V&H	2x10kA	2x50A+SL
X2R	packb48	1.43	0.48	0.48				V&H	2x10kA	2 x50A
X3	packc0u	1.43	0.48	0.48	7.5			V&H	2x10kA	3x50A+200A
X3	packc0d	1.43	0.48	0.48	7.5			V&H	2x10kA	3x50A+200A
X2R	packc12	1.43	0.48	0.48				V&H	2x10kA	2x50A
X2L	packc13	1.43	0.48	0.48				V&H	2x10kA	2x50A+SL
X1V	packc16	1.83	0.48			450	25			3x50A
X1H	packc17	1.83		0.48		450	25			3 x 50A+ SL

**Total of 6 pairs of HTS leads + 3 pairs of spares (for each different spool box).**

Current solution is to use two 6 kA leads in parallel connection to make up a 10 kA lead.

- Approach to HTS leads
  - Base line => Existing ASC type 6 kA leads used; 2x2 pairs for a spool box
  - Existing 6kA HTS leads to be used or modified slightly the design to accommodate 9.5 kA (10 kA nominal) as a single pair.
    - ASC leads – only more copper needed for the upper section
    - IGC leads – advantage => removable without taking the spool box apart.
  - CERN HTS leads (as a back-up)
    - Modify the design to be suitable for our application.
    - Possible production scenario:
      - Buy the HTS tapes from ASC.
      - CERN makes and characterize the stacks of tapes.
      - US vendor fabricate the leads.

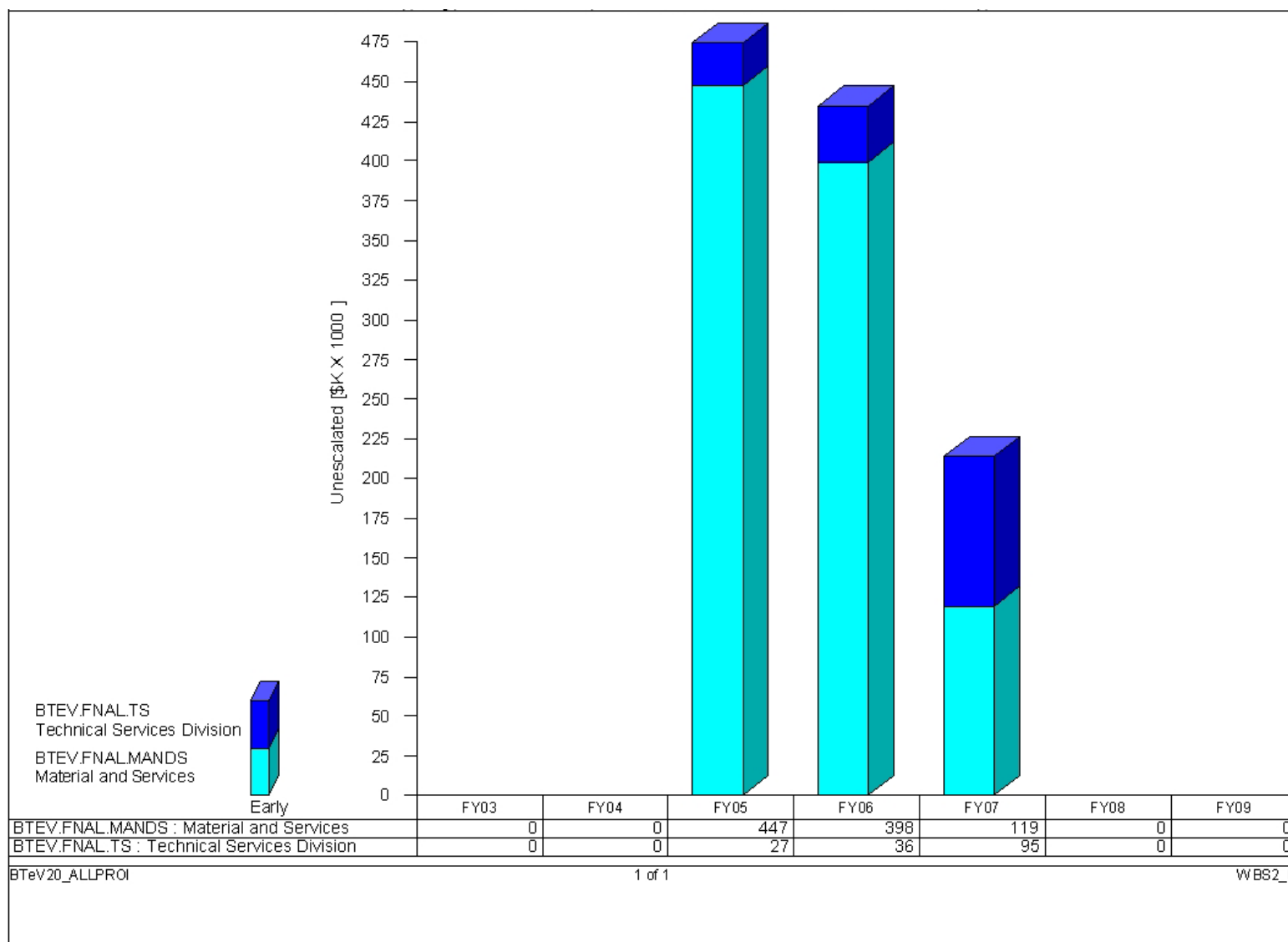
## ■ Procurement Plan

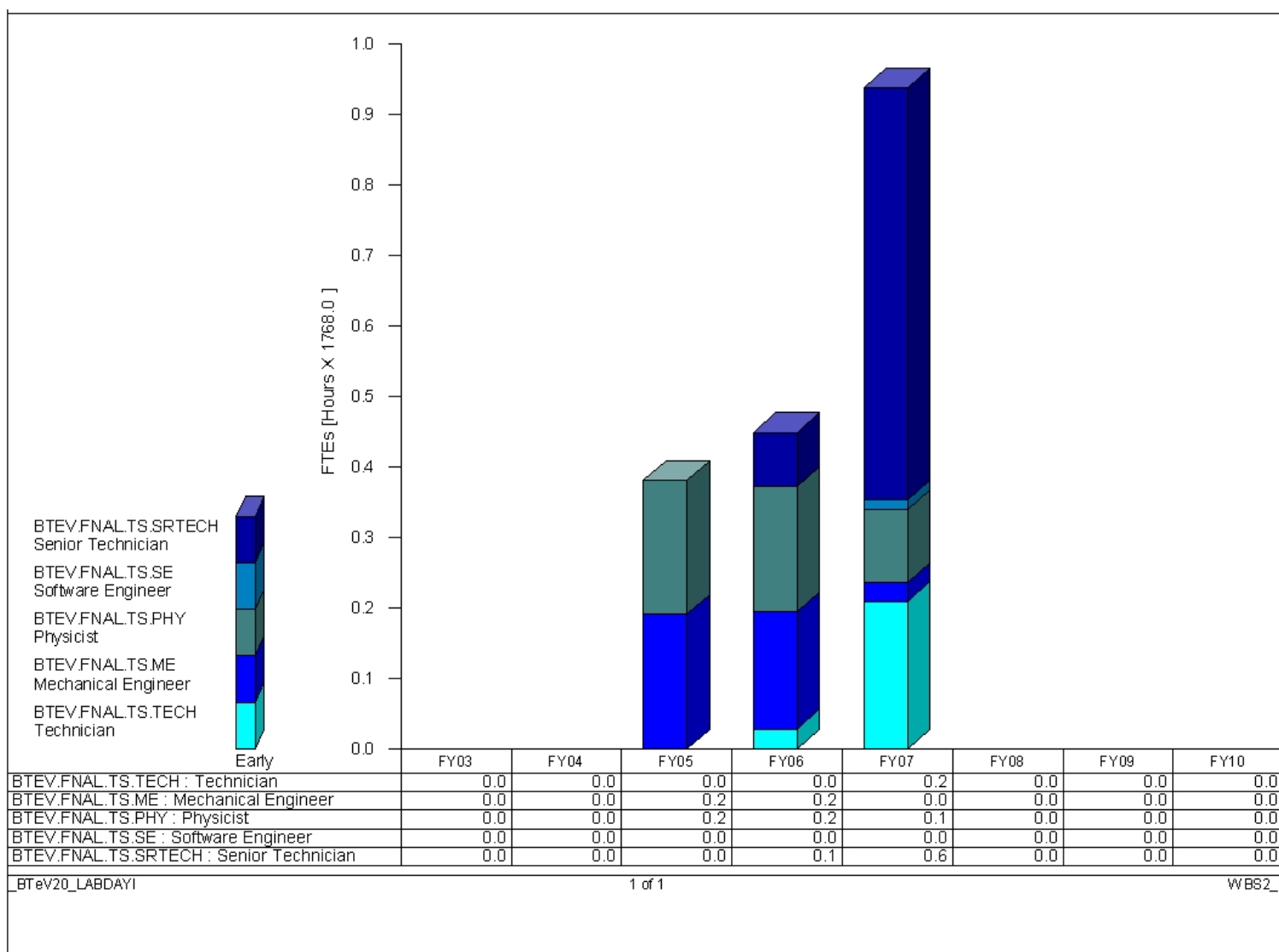
- Preliminary discussions with vendors to determine their capability and willingness to make HTS leads for the Tevatron
- 'First choice' would be to choose from qualified vendors who demonstrated to make leads for Fermilab
  - LOI to qualified vendors – July 04
  - RFP to qualified vendors – December 04
  - Issue a purchase order – conditional: the first pair of leads have to be tested and accepted before rest of the production continues
- Continuing to pursue CERN design as a back-up plan until we are sure 'First choice' can be achieved
  - Test an existing 13 kA lead
  - Modify the design
  - Issue an RFP for procuring a prototype leads
  - Test the prototype leads
  - Issue an RFP for the production leads
  - Issue a purchase order – conditional: the first pair of leads have to be tested and accepted before rest of the production continues

- CERN developed a 13 kA lead for LHC
  - Complete working design is available
  - We can get help from CERN for design modifications









Activity ID	Activity Description	Original Duration	Early Start	Early Finish	FY04	FY05	FY06	FY07	FY08	FY09
1.1.4.15	54-3	120d	04Aug08	28Jan09					1.1.4.15	
1.1.4.16	Production Oversight in ICB	680d	15May06	28Jan09			1.1.4.16			
1.2	New Spools	1347d	02Feb04	01Jun09	1.2					
1.2.1	HTS LEADS	817d	03May04	24Jul07	1.2.1					
1.2.1.1	H-Spool Leadtest	106d	03May04	30Sep04	1.2.1.1					
1.2.1.2	Design Modifications (if any)	60d	01Oct04	29Dec04	1.2.1.2					
1.2.1.3	Bidding Process	120d	30Dec04	21Jun05	1.2.1.3					
1.2.1.4	Bidding Process for spares	120d	30Dec04	21Jun05	1.2.1.4					
1.2.1.5	Contract Evaluation	71d	22Jun05	30Sep05	1.2.1.5					
1.2.1.6	Option to buy 2nd batch	20d	03Oct05	28Oct05	1.2.1.6					
1.2.1.7	Option to buy 2nd Batch of spares	20d	03Oct05	28Oct05	1.2.1.7					
1.2.1.8	Production Oversight	240d	03Oct05	08Sep06	1.2.1.8					
1.2.1.9	HTS Lead Testing	130d	11Sep06	16Mar07	1.2.1.9					
1.2.1.10	HTS Lead Testing for spares	90d	19Mar07	24Jul07	1.2.1.10					

- Selection of vendor – issuance of PO;      Oct 05
  - ASC, IGC, other potential vendors
- Delivery of the first pair;      February 06
- Delivery of the last pair;      September 06

- Identify qualified potential vendors
- Release RFP for qualified vendors
- First pair of HTS lead test

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- Risks
    - Lack of qualified vendors
    - Schedule
  - Mitigation
    - CERN design; complete control even the lead can be built at Fermilab
    - Issue RFP as soon as possible

- The proposed baseline HTS lead design is essentially the same design which has been successfully used at the Tevatron. The only risk is that the vendor have forgotten how to make the leads.
- The cost estimate is based on using two pairs of 6kA leads in parallel. Preliminary test results shows that we might be able to use a pair of slightly modified 6 kA leads => cost reduction by close to factor of two.
- Proposed design modifications for reducing the cost of leads have also very low risk since we will keep the design changes minimal - which will not affect basic operation of the lead.
- Production schedule is reasonable. In the past vendors were able to make similar quantity leads within even a shorter amount of time.
- Back up solution – using CERN lead design - looks very viable.